MEASURING SUBCLUSTERS IN GALAXY CLUSTERS

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We assume that there are K_c subclusters and K_f fields (foreground or background) in a cluster region. Then, the distribution of all galaxies in this region can be described as follow:

$$\Phi = \sum_{c=1}^{K_c} \Phi_c + \sum_{f=1}^{K_f} \Phi_f = \sum_{c=1}^{K_c} n_c \phi_c \mu_c + \sum_{f=1}^{K_f} n_f \phi_f \mu_f. \quad (1)$$

where, n_c and n_f are normalized numbers of subcluster members and field galaxies. ϕ_c, ϕ_f, are their normalized distributions in radial velocity space. Both of them can be assumed as Gaussian. μ_c and μ_f are normalized distributions in the projected surface of the celestial sphere. For field galaxies, it's uniform, and for subcluster members, usually we use the King's approximate formulae. Distribution parameters and their uncertainties can be found by using the standard maximum likelihood method. And membership probabilities of the ith galaxy belonging to the cth subcluster can be calculated as $P_c(i) = \Phi_c(i)/\Phi(i)$.

Furthermore, we introduce a new index E_c to measuring the effectiveness of membership determination of the cth subcluster:

$$E_c = 1 - N \sum_{i=1}^{N} \{P_c(i)\,[1 - P_c(i)]\} \left\{ \sum_{i=1}^{N} P_c(i) \cdot \sum_{i=1}^{N} [1 - P_c(i)] \right\}^{-1} \quad (2)$$

By using the approach mentioned above. The Virgo cluster area is divided into 10 subcluster and 1 background field successfully (Shao 1996).

References

Shao, Z.Y. 1996, Ph.D. thesis, Shanghai Astronomical Obs.

https://doi.org/10.1017/S0074180900113312 Published online by Cambridge University Press